



US Army Corps  
of Engineers®  
Portland District

# **TILLAMOOK BAY FEDERAL PROJECT SEDIMENT QUALITY EVALUATION REPORT**



*Garibaldi Boat Basin*

**August 2007**

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## ACRONYMS

Ag	Silver
As	Arsenic
Cd	Cadmium
CoC	Contaminate of concern
Cr	Chromium
CRM	Columbia River Mile
Cu	Copper
DMEF	Dredge Material Evaluation Framework
EPA	Environmental Protection Agency
Hg	Mercury
J	Laboratory estimated value detected between MRL & MDL
MDL	Method Detection Limit
MLLW	Mean Lower Low Water
MRL	Method Reporting Limit
ND	Non-detected at MRL or MDL
NES	Newly Exposed Surface
Ni	Nickel
PAH	Polynuclear Aromatic Hydrocarbon
Pb	Lead
PCB	Polychlorinated Biphenyl
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RMT	Regional Management Team
Sb	Antimony
SEF	Sediment Evaluation Framework
SL	Screening Level
Tier II	Physical (a) & Chemical (b) analyses
Tier III	Bioassay & Bioaccumulation analyses
TOC	Total Organic Carbon
TVS	Total Volatile Solids
U	Laboratory non-detect at MRL
USFWS	U. S. Fish & Wildlife Service
WDNR	Washington Department of Natural Resources
Zn	Zinc
Σ	Total value (i.e. DDT + DDE + DDD)

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**ABSTRACT**

Tillamook Bay is located on the northern Oregon coast, approximately 75 miles west of Portland and 50 miles south of the mouth of the Columbia River. The Estuary is 3 miles wide and 6 miles long. It is supplied with freshwater by five rivers, draining an area of 533 square miles and is the third largest of the estuaries in the District.

The authorized project includes a channel 18 feet deep and 200 feet wide to a turning basin 18 feet deep and 500 feet wide in Miami Cove. These dimensions are not required by present usage, so an approach channel, 12 feet deep, 100 feet wide and approximately 1,200 feet long, leads from deep water in the bay to the Garibaldi Boat Basin. From there an 8 foot deep, 75 feet wide and approximately 1,600 feet long channel, continues along the north edge of the turning basin to the Old Mill Marina. The Garibaldi Boat Basin access channel is maintained to 12 feet deep MLLW (see figure 1).

The channel in front of the Garibaldi Boat Basin, from river mile 3+00 to 3+26, is subjected to eddy currents from tidal action and the sediments transported downstream by the Miami River settle in the channel. Dredging of the inside channel is generally limited to this area. About 30,000 CYs every 5 to 8 years will be dredged using a pipeline dredge, or clamshell and barge. Material usually is placed upland with return water to the bay.

Portland District evaluates sediment from the Tillamook project on a, as needed, basis. Physical and chemical evaluation sampling was performed at the Tillamook entrance channel and Garibaldi Boat Basin access channel starting in 1980 and continued in, 1985 (May and July), 1990, 1999 and 2007. The results of these studies revealed the sediment to be predominately sand in the outer channel (>65% sand) and finer material within the boat basin (>65% fines), with a mean total organic carbon of ~2.5%. Sediment from the previous studies have met the regional guidelines for in-water placement or up-land placement under the Clean Water Act, with the exception of the non-carcinogenic PAH, fluoranthene in the 1999 sampling event, which exceeded the 1700 ug/kg (ppb) screening level with a concentration of 2900 ug/kg level in 1 sample. The material from that dredging event was placed up-land (27,000CY); the return water was impounded and sampled prior to release back to the bay. No fluoranthene was detected in the return water.

One (1) gravity-core sample, 4 surface-grab samples and 1 composite surface-grab sample were collected in the Tillamook Bay federally maintained channel near the boat basin. All samples were submitted for physical analyses; with grain-size ranging from 68.4% to 32.5% (mean 43.3%) poorly graded sand (includes shell hash). Silt and clay ranged from 67.5% to 31.6% (mean 56.7%), with total organic carbon content ranging from 3.6% to 1.5% (mean 2.6 %). The outer channel averaged 56.4% sand and 43.4% fine-grained material. The inner channel averaged 19.5 % sand and 76.8% fine-grained material. The composite sample from nearshore was 81.3% sand, with 18.1% fines (see figure 2).

All samples were submitted for chemical analyzes to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous

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extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT) (total) analysis. The chemical analyses indicated only very low levels of contamination in any of the samples. Laboratory detection levels were sufficiently low enough to evaluate material proposed for dredging.

Sediment represented by samples collected during this sampling event meet the guidelines established in the SEF for unconfined in-water placement without further characterization.

## **INTRODUCTION**

This report characterizes the sediment to be dredged at Tillamook Federal Project for the purposes of dredging and disposal. The sampling and analysis objectives are stated in the Sampling and Analysis Plan (SAP August 2007), and are also listed below. This report will outline the procedures used to accomplish these objectives.

### **Project Site Location and Description**

Tillamook Bay is located on the northern Oregon coast, approximately 75 miles west of Portland and 50 miles south of the mouth of the Columbia River. The Estuary is 3 miles wide and 6 miles long. It is supplied with freshwater by five rivers, draining an area of 533 square miles and is the third largest of the estuaries in the District.

The authorized project includes a channel 18 feet deep and 200 feet wide to a turning basin 18 feet deep and 500 feet wide in Miami Cove. These dimensions are not required by present usage so an approach channel, 12 feet deep, 100 feet wide and approximately 1,200 feet long, leads from deep water in the bay to the Garibaldi Boat Basin. From there an 8 foot deep, 75 feet wide and approximately 1,600 feet long channel, continues along the north edge of the turning basin to the Old Mill Marina. The Garibaldi Boat Basin access channel is maintained to 12 feet deep MLLW (see figure 1).

The channel in front of the Garibaldi Boat Basin, from river mile 3+00 to 3+26, is subjected to eddy currents from tidal action and the sediments transported downstream by the Miami River settle in the channel. Dredging of the inside channel is generally limited to this area. About 30,000 CYs every 5 to 8 years will be dredged using a pipeline dredge, or clamshell and barge. Material usually is placed upland with return water to the bay.

Currently the channel inside the boat basin is authorized and maintained to a depth of 12' below MLLW and in the outer channel and turning basin it is authorized to an 18' depth, but is also maintained to a 12' depth. Project conditions inside the boat basin (fine-grained material) indicate a <3' dredge prism. In the outer channel (sandy material) the only shoaling occurs in front of the boat basin, where the dredge prism varies from 0' to 8" in depth; except for this area the outer channel to the ocean is naturally deep and does not require maintenance dredge. Typically ~30,000 CY of material is dredged every 5 to 8 years.

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## **Sampling and Analysis Objectives**

- Characterize sediments in accordance with the regional dredge material testing manual protocols:
  - Sediment Evaluation Framework (SEF), 2006 (regional guidance for the Clean Water Act).
  - The Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities – Testing manual (Upland Testing Manual).
  - Evaluation of Dredged Material Proposed for Ocean Disposal (Green Book).
- Collect, handle and analyze representative sediment from Tillamook Bay/Garibaldi Boat Basin in accordance with protocols and Quality Assurance/Quality Control (QA/QC) requirements.
- Characterize sediments to be dredged for evaluation of suitability of in-water disposal.
- Analyze for full suite of physical parameters for all samples and chemical parameters as outlined in the SEF (2006) for samples within the 2 basin areas. SEF – Table 7.2 (Appendix C of this report) contains the list of analytes, methods of analysis and reporting limits required.

## **PREVIOUS STUDIES**

Sediment evaluation sampling was performed at the Tillamook Bay in 1980, 1985, 1990, and 1999 (reports available at <https://www.nwp.usace.army.mil/ec/sqer.asp>).

**1980 December**, sediment samples were obtained for elutriate, chemical, and physical analysis from the Tillamook Bay entrance channel and the Garibaldi Boat Basin access channel. Water was collected and chemically analyzed for comparison with the navigation channel elutriates.

**1985 May and July**, sediment was collected from the Garibaldi Boat Basin access channel for physical and chemical analysis.

**1990 March**, sediment samples were collected at 6 stations along the channel fronting the Garibaldi Boat Basin and the entrance to the basin. Sediments outside the entrance were predominately sandy material with increasing amounts of gravel towards the mouth of the Miami River. Samples from the boat basin entrance channel were fine grained material (fines 50.3% to 71.5%) with volatile solids ranging from 7.3% to 11.6%. Material was similar to material collected in 1980 and 1985. Arsenic, copper, and nickel

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were elevated compared to other Oregon locations but not above established concern levels. All other potential contaminants for which analyses were conducted were below method detection limits. All material was considered to be acceptable for unconfined in-water placement.

**September 1999.** Six sediment samples were collected in Tillamook Bay at Garibaldi Boat Basin, September 15, 1999. All 6 samples were sent to Sound Analytical Services, Inc. laboratory in Tacoma, WA, for physical analyses and for the following chemical analyses: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, chlorinated organic compounds, miscellaneous extractables, and polynuclear aromatic hydrocarbons (PAH). Samples from 3 stations within the boat basin were composited for tributyltin (TBT).

Median grain size for all samples is 0.07mm, with 54.1% sand and 47.5% fines. The chemical analyses, for all but one contaminant of concern, were below screening levels of the DMEF. The non-carcinogenic PAH, fluoranthene, exceeded the 1700 ug/kg (ppb) screening level with a concentration of 2900 ug/kg level in the TB-BC-05 sample. The DEQ cleanup level for fluoranthene in soil is 8,000 mg/kg (ppm).

All sediments tested were placed in an upland site with monitoring of return water to Tillamook Bay during the 84-hour period of time the dredge was operating in the vicinity of the material represented by the sample of concern.

Fourteen water samples were collected during the 84-hour period and were composited into 3 samples for analysis of all PAHs. The laboratory report showed non-detect (ND) at the method detection limit (MDL) for all samples.

## **CURRENT SAMPLING EVENT/DISCUSSION**

### **Sampling Requirements**

Sediment from a boat basin is generally ranked as “moderate” in the Sediment Evaluation Framework (SEF) due to the potential for contamination. The guidelines for “moderate” ranking in the SEF for sediment with homogeneous nature indicate one sample for every 40,000 CYs of material dredged. If sediments were considered heterogeneous, one sample would be required for every 20,000 CY of material to be dredged. The 1 gravity-core and 1 surface-grab sample inside the boat basin (fine-grained material) and 3 surface-grab samples in the outer channel (sandy material) exceed both of these SEF guidelines to characterize the estimated 30,000 CYs of sediment proposed for dredging.

In addition to the ranking and type of sediment (heterogeneous or homogeneous), grain-size, organic content, depth of dredging prism, frequency of shoaling and frequency dredging influence the need to characterize the new surface material after dredging. At the Tillamook Bay/Garibaldi Boat Basin Project, the dredging prism in the boat basin channel varies in depth from 0 to 3 feet, with an outer channel dredging prism depth up to 14 feet.



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Because the dredging prism is homogeneous in nature, rapidly shoaling, frequently dredged and from a consistent non-contaminated source, has the same non-contaminated surface exposed after each annual dredging event, surface grab samples are considered adequate to characterize the outer channel sandy material. Three (3) gravity-core samples were originally planned for the inner boat basin fine-grained channel material. However, after finding that the Port of Garibaldi had recently dredged much of the inner boat basin, it was determined that only 1 gravity core was needed in the fine-grained area not dredged by the Port. The surface-grab sample TB-P- 05 was taken to represent the new surface material (NSM) following the Ports dredging of the boat basin. One composite sample was collected in a nearshore area that the Port wanted to verify as not contaminated (sample TB -P-123).

One (1) gravity core sample, 4 surface grab samples and 1 composite surface-grab were collected in the Tillamook Bay federally maintained channel near and within the boat basin. All samples were submitted for physical analyses, with grain-size ranging from 68.4% to 32.5% (mean 43.3%) poorly graded sand (includes shell hash), silt and clay ranged from 67.5% to 31.6% (mean 56.7%), with total organic carbon content ranging from 3.6% to 1.5% (mean 2.6 %). The outer channel averaged 56.4% sand and 43.4% fine-grained material. The inner channel averaged 19.5 % sand and 76.8% fine-grained material. The composite sample from nearshore was 81.3% sand, with 18.1% fines (see figure 2).

All samples were submitted for chemical analyzes to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT) (total) analysis. The chemical analyses indicated only very low levels of contamination in any of the samples. Laboratory detection levels were sufficiently low enough to evaluate material proposed for dredging.

Sediment represented by samples collected during this sampling event meet the guidelines established in the Sediment Evaluation Framework (SEF) for unconfined in-water placement without further characterization.

Table 1 lists the Project Team their duties and responsibilities for the sediment-sampling project at the Tillamook Bay Federal Project.

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**TABLE 1: PROJECT TEAM**

Task/Responsibility	CENWP Ruth Abney	CENWP Tim Sherman	CENWP Mark Siipola	CENWP Donna Ebner	A/E Contractor
Overall Project Management		X			
Sampling Plan Development	X	X			
Agency Coordination		X			
Positioning/Log Record	X			X	X
Sediment Sampling		X		X	
Physical Analysis					X
Chemical Analysis					X
Final Report		X			
Technical Review			X		
Boat & Operator					X

Table 2 lists the sampling station coordinates within Tillamook Federal Project (see figure 2). Coordinates are based on the Lambert Projection for Oregon; South Zone (NAD 83, U.S. Survey Feet) Datum is Mean Lower Low Water, (MLLW is 3.09 feet below National Geodetic Vertical Datum at Garibaldi boat basin, 1947 adjustment).

**TABLE 2: SAMPLE LOCATION COORDINATES (NAD 83, OREGON STATE PLANE SOUTH)**

082207TB-P-01	123° 54' 44.1" 45° 33' 14.1"
082207TB-P-02	123° 54' 40.2" 45° 33' 15.3"
082207TB-P-03	123° 54' 31.1" 45° 33' 16.0"
082207TB-GC-04	123° 54' 42.1" 45° 33' 17.4"
082207TB-P-05	123° 54' 42.8" 45° 33' 20.8"
Composite of 3 surface grabs for 1 analysis 082207TB-P-123	123° 54' 33.4" 45° 33' 18.0"
	123° 54' 36.6" 45° 33' 18.0"
	123° 54' 39.9" 45° 33' 19.4"

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## **RESULTS**

### **Physical and Volatile Solids (ASTM methods)**

Six (6) samples were submitted for physical analyses and the data are presented in Table 3. One (1) gravity core sample and 4 surface grab samples were collected in the Tillamook Bay federally maintained channel near the boat basin. All samples were submitted for physical analyses, with grain-size ranging from 68.4% to 32.5% (mean 43.3%) poorly graded sand (includes shell hash), silt and clay ranged from 67.5% to 31.6% (mean 56.7%), with total organic carbon content ranging from 3.6% to 1.5% (mean 2.6 %). All samples were submitted for chemical analyzes to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT) (total) analysis.

### **Metals (EPA method 6020/7471), Total Organic Carbon (EPA method 9060)**

Six (6) samples were submitted for testing and the data are presented in Table 4. The TOC ranged from 0.99% to 3.58% in the samples.

Low levels of all metals tested for were found in all samples, but none approached their respective screening levels (SL).

### **Pesticides/PCBs (EPA method 8081A/8082)**

Six (6) samples were tested for pesticides/PCBs and the data are presented in Table 5. No significant levels of PCBs or pesticides were detected in any of the samples. All reporting limits or estimated detections are well below the SEF Marine Screening Level 1, with the exception of chlordane. The chlordane detection levels (ranging from 5.3 to 8.9 ppb) in all 6 samples exceeded the screening level of 2.8 ppb. Chlordane detection levels were elevated due to matrix interference during the analysis. The laboratory provided component chlordane (alpha and gamma), with sufficiently low detection limits individually, to evaluate chlordane as not present at levels of concern. There is no past history of chlordane at this location.

### **Chlorinated Hydrocarbons, Phthalates, Phenols and Miscellaneous Extractables (EPA method 8270)**

For each of the 6 samples, laboratory analyses were conducted for chlorinated hydrocarbons, phthalates, phenols and miscellaneous extractables. The data are presented in Tables 7, 8, 9 and 10. All levels for chlorinated hydrocarbons, phthalates, phenols and miscellaneous extractables were found to be below their respective SEF Marine Screening Level 1, with sufficiently low detection levels for evaluation.

### **Polynuclear Aromatic Hydrocarbons (EPA method 8270C)**

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For each of the 6 samples, laboratory analyses were conducted for PAHs. The Low Molecular Weight PAH data is presented in Tables 11 and the High Molecular Weight PAH data is presented in Table 12. Low levels of some “low molecular weight” PAHs and some “high molecular weight” PAHs were found in all the samples and did not approach their respective SEF Marine Screening Level 1, with sufficiently low detection levels for evaluation.

## **CONCLUSION**

Collection and evaluation of the sediment data was completed using guidelines from the SEF. The SEF is a regional manual developed jointly with regional EPA, NMFS, USFW, Corps, Oregon Department of Environmental Quality and Washington Departments of Ecology and Washington Natural Resources. This document is guidance for implementing the Marine Protection, Research, and Sanctuaries Act and Clean Water Act (40 CFR 230), Section 404 (b)(1). The screening levels used are those adopted for use in the SEF, interim final 2006.

One (1) gravity-core sample, 4 surface-grab samples and 1 composite surface-grab sample were collected in the Tillamook Bay federally maintained channel and boat basin. All samples were submitted for physical analyses; with grain-size ranging from 68.4% to 32.5% (mean 43.3%) poorly graded sand (includes shell hash). Silt and clay ranged from 67.5% to 31.6% (mean 56.7%), with total organic carbon content ranging from 3.6% to 1.5% (mean 2.6 %). The outer channel (near the boat basin) averaged 56.4% sand and 43.4% fine-grained material. The inner channel averaged 19.5 % sand and 76.8% fine-grained material. The composite sample from nearshore was 81.3% sand, with 18.1% fines (see figure 2).

All samples were submitted for chemical analyzes to include: metals, total organic carbon (TOC), pesticides/polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, polynuclear aromatic hydrocarbons (PAHs) and organotin (TBT) (total) analysis. The chemical analyses indicated only very low levels of contamination in any of the samples. Laboratory detection levels were sufficiently low enough to evaluate material proposed for dredging.

Sediment represented by samples collected during this sampling event meet the guidelines established in the SEF for unconfined in-water placement without further characterization.

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**TABLE 4: PHYSICAL AND VOLATILE SOLIDS (ASTM METHODS)**

Sample I.D.	Percent		
	Gravel	Sand	Silt/Clay
082208TB-P-01	0.80	67.6	31.6
082208TB-P-02	0.10	43.9	56.0
082208TB-P-03	0.60	56.9	42.5
082208TB-GC-04	8.0	24.5	67.5
082208TB-P-05	0.10	13.8	86.1
082208TB-P-123	0.6	81.3	18.1
Mean	1.7	48.0	50.3
Minimum	0.10	13.8	18.1
Maximum	8.0	81.3	86.1

**TABLE 5: INORGANIC METALS AND TOTAL ORGANIC CARBON**

Sample I.D.	As	Sb	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)										%
082208TB-P-01	3.27	0.07	0.160	31.9	42.3	4.50	0.03	57.8	0.08	93.0	1.51
082208TB-P-02	4.33	0.08	0.215	31.5	40.2	5.57	0.32	46.6	0.12	62.8	2.40
082208TB-P-03	3.90	0.08	0.251	34.9	40.4	4.94	0.027	50.9	0.07	67.3	1.98
082208TB-GC-04	4.49	0.08	0.265	33.7	43.0	6.42	0.041	41.9	0.12	69.7	3.51
082208TB-P-05	5.20	0.08	0.323	35.9	49.6	8.23	0.044	44.1	0.13	77.3	3.58
082208TB-P-123	3.26	0.04	0.089	15.8	14.3	3.00	0.009	15.8	0.08	32.5	0.99
Screening level (SL)	57	150	5.1	260	390	450	0.41	--	6.1	410	--
-- SL not established.											

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**TABLE 6: PESTICIDES AND PCBS**

Sample I.D.	ug/kg (ppb)										
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	Chlordane			Dieldrin	Heptachlor	gamma-BHC	Total PCBs
					Technical	Alpha	Gamma				
082208TB-P-01	<0.21	<0.17	0.19 J	<0.26	<5.8	<0.23	<0.064	<0.50	<0.15	<0.26	<2.9
082208TB-P-02	<1.10	<0.22	<0.14	<1.10	<7.4	<0.25	0.39 J	<0.63	<0.23	<1.10	<3.7
082208TB-P-03	<0.24	<0.20	<0.31	<0.30	<6.8	<0.23	<0.064	<0.58	<0.16	<0.30	<3.4
082208TB-GC-04	<0.27	<0.22	<0.96	<0.51	<7.5	<0.26	<0.26 i	<0.64	<0.90	<0.33	<3.8
082208TB-P-05	<0.32	<0.26	<0.17	<0.1.3	<8.9	<0.30	<0.49 i	<0.76	<1.20	<1.30	<4.5
082208TB-P-123	<0.19	<0.16	0.25 J	<0.56	<5.3	<0.23	<0.096 i	<0.45	<0.76	<0.24	<2.7
Screen level (SL)	16	9	12	9.5	2.8			1.9	1.5	--	130
-- SL not established.											
J = The result is an estimated concentration that is less then the MRL but greater than or equal to the MDL.											
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).											
I = The MRL/MDL has been elevated due to matrix interference.											

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**TABLE 7: CHLORINATED HYDROCARBONS**

Sample I.D.	Hexachlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,4-Dichlorobenzene
	ug/kg (ppb)			
082208TB-P-01	<2.1	<4.5	<5.0	<5.0
082208TB-P-02	<2.6	<5.7	<6.3	<6.3
082208TB-P-03	<2.4	<5.2	<5.8	<5.8
082208TB-GC-04	<2.7	<5.7	<6.4	<6.4
082208TB-P-05	<b>2.6</b>	<6.8	<7.6	<7.6
082208TB-P-123	<0.99	<4.1	<4.5	<4.5
Screening level (SL)	22	31	35	110
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).				

**TABLE 8: PHTHALATES**

Sample I.D.	bis(2-Ethylhexyl) phthalate	Butyl-benzyl-phthalate	Di-n-butyl-phthalate	Di-n-octyl phthalate	Diethyl-phthalate	Dimethyl-phthalate
	ug/kg (ppb)					
082208TB-P-01	<b>16.0 J</b>	<5.5	<b>22.0</b>	<2.9	<2.3	<1.7
082208TB-P-02	<16.0	<7.0	<b>28.0</b>	<3.7	<2.9	<2.2
082208TB-P-03	<b>18.0 J</b>	<6.4	<b>46.0</b>	<3.4	<2.6	<2.0
082208TB-GC-04	<b>22.0 J</b>	<7.1	<b>23.0</b>	<3.8	<2.9	<2.2
082208TB-P-05	<b>32.0 J</b>	<8.4	<b>44.0</b>	<4.5	<3.4	<2.6
082208TB-P-123	<11.0	<5.0	<b>21.0</b>	<2.7	<2.1	<1.6
Screening level (SL)	1300	63	1400	6200	200	71
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).						
J = The result is an estimated concentration that is less then the MRL but greater than or equal to the MDL.						



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**TABLE 9: PHENOLS**

Sample I.D.	Phenol	2-Methyl phenol	Pentachloro phenol	4-Methyl phenol	2,4-Dimethyl phenol
	ug/kg (ppb)				
082208TB-P-01	<b>57.0</b>	<2.6	<34.0	<2.6	<9.4
082208TB-P-02	<b>63.0</b>	<3.3	<44.0	<3.3	<12.0
082208TB-P-03	<b>63.0</b>	<3.0	<40.0	<3.0	<11.0
082208TB-GC-04	<b>53.0</b>	<3.3	<44.0	<b>4.3 J</b>	<13.0
082208TB-P-05	<b>72.0</b>	<3.9	<52.0	<3.9	<15.0
082208TB-P-123	<b>38.0</b>	<2.4	<31.0	<b>6.7 J</b>	<8.5
Screening level (SL)	420	63	400	670	29
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).					
J = The result is an estimated concentration that is less then the MRL but greater than or equal to the MDL					

**TABLE 10: MISCELLANEOUS EXTRACTABLES**

Sample I.D.	Hexachloro-butadiene	Benzoic Acid	Benzyl Alcohol	Dibenzofuran	N-Nitroso diphenylamine
	ug/kg (ppb)				
082208TB-P-01	<4.3	<170	<b>5.4 J</b>	<2.1	<2.8
082208TB-P-02	<5.5	<210	<4.6	<2.6	<3.5
082208TB-P-03	<5.0	<200	<4.2	<2.4	<3.2
082208TB-GC-04	<5.5	<220	<4.6	<2.7	<3.6
082208TB-P-05	<6.5	<250	<5.5	<b>3.9 J</b>	<4.2
082208TB-P-123	<3.9	<150	<3.3	<1.9	<2.5
Screening level (SL)	11	650	57	540	28
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).					
J = The result is an estimated concentration that is less then the MRL but greater than or equal to the MDL.					

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**TABLE 11: POLYNUCLEAR AROMATIC HYDROCARBONS (PAHS), LOW MOLECULAR WEIGHT ANALYTES**

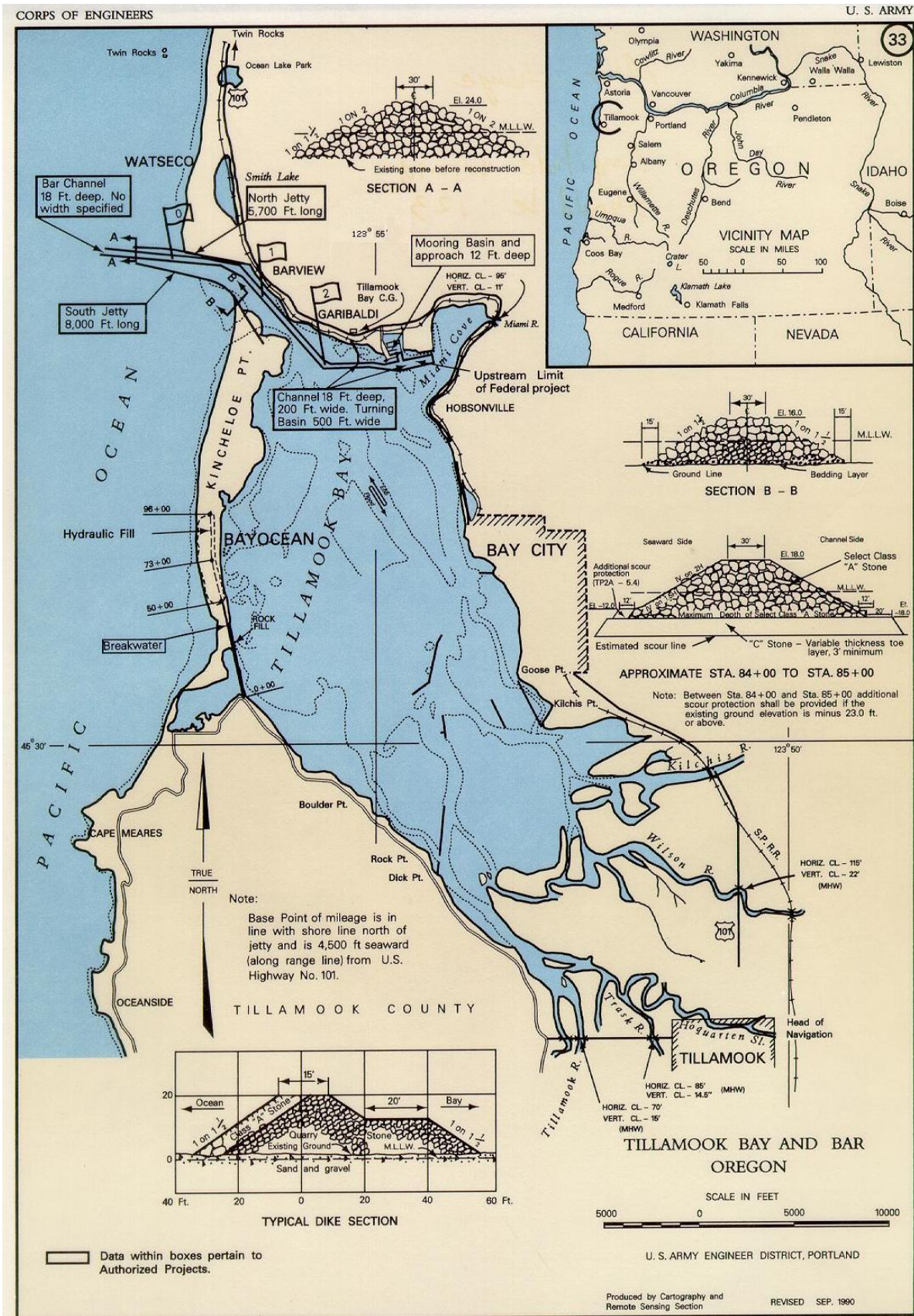
Sample I.D.	Acenaph- thene	Acenaph- thylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen- anthrene	Total Low PAHs
	ug/kg (ppb)							
082208TB-P-01	<2.4	<2.1	<b>3.7 J</b>	<1.9	<3.8	<4.0	<b>9.6 J</b>	<b>13.3 J</b>
082208TB-P-02	<3.1	<2.6	<b>21.0</b>	<b>3.4 J</b>	<4.8	<5.0	<b>86.0</b>	<b>110.4 J</b>
082208TB-P-03	<2.8	<2.4	<3.2	<2.2	<4.4	<b>4.8 J</b>	<b>11.0</b>	<b>15.8 J</b>
082208TB-GC-04	<3.1	<2.7	<b>5.5 J</b>	<2.5	<4.9	<5.1	<b>24.0</b>	<b>29.5 J</b>
082208TB-P-05	<b>4.1 J</b>	<3.2	<b>7.1 J</b>	<b>4.9 J</b>	<5.8	<6.0	<b>30.0</b>	<b>46.1 J</b>
082208TB-P-123	<2.2	<1.9	<2.5	<1.7	<3.4	<3.6	<b>2.7 J</b>	<b>2.7 J</b>
Screen level (SL)	500	560	960	540	670	2100	1500	5200
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)								
J = The result is an estimated concentration that is less then the MRL but greater than or equal to the MDL.								

**TABLE 12: POLYNUCLEAR AROMATIC HYDROCARBONS (PAHS), HIGH MOLECULAR WEIGHT ANALYTES**

Sample I.D.	Benzo(a)-anthracene	Benzo(b)-fluro-anthene	Benzo(k)-fluro-anthene	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Dibenz(a,h)-anthracene	Indeno-(1,2,3-cd)-pyrene	Fluor-anthene	Total High PAHs
	ug/kg (ppb)										
082208TB-P-01	5.9 J	8.2 J	3.1 J	5.0 J	7.7 J	16.0	5.8 J	<2.6	3.9 J	18.0	73.6 J
082208TB-P-02	57.0	47.0	15.0	17.0	54.0	160.0	36.0	<3.3	20.0	140.0	546.0
082208TB-P-03	4.9 J	6.0 J	3.1 J	<3.0	8.4 J	15.0	<3.4	<3.0	<3.0	15.0	52.4 J
082208TB-GC-04	16.0	19.0	15.0	10 J	28.0	74.0	13.0	<3.3	11.0	81.0	267.0 J
082208TB-P-05	19.0	25.0	16.0	11.0 J	37.0	73.0	15.0	<3.9	11 J	79.0	286.0 J
082208TB-P-123	<2.7	3.0 J	2.4 J	<2.4	3.3 J	7.2 J	<2.7	<2.4	<2.4	5.7 J	21.6 J
Screen level (SL)	1300	b + k = 3200		670	1400	2600	1600	230	600	1700	12000
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).											
J = The result is an estimated concentration that is less then the MRL but greater than or equal to the MDL.											

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**FIGURE 1: TILLAMOOK BAY VICINITY MAP**





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**FIGURE 2: SEDIMENT SAMPLING LOCATIONS**

